of a diameter ſufficient for the worm to extend its full length, as far as I could diſcover. The humours of the eye were beginning to grow opake like a chilled jelly, and became altogether ſo afterwards, as I was informed.

As this is a very uncommon circumſtance and may affect ſome philoſophical doctrines, it is much to be lamented that the horſe had not been purchaſed, and the eye diſſected for better examination. That there was a living, ſelf-moving worm within the ball of the horſe's eye, free from all deception or miſtake, I am moſt confident. How this worm got there, or if bred in ſo remarkable a place, where its parents came from, or how they contrived to depoſite their ſemen or convey their egg into the eye of an horſe, I leave for others to determine.

N° XIX.

An improved Method of Quilling a Harpſichord, by F. HOPKINSON, *Eſquire.*

Read Dec. 5, 1783.

MUCH of the pleaſure and effect in performing on a harpſichord depends on the equality of what is called *the touch;* and this is principally owing to a continuance of uniformity in the ſpring of the little quills, which by their impulſe ſet the ſtrings in vibration. Theſe quills, in the preſent manner of applying them, will not retain their elaſticity for any length of time, but require conſtant repair; which is one of the moſt troubleſome and difficult operations in keeping the inſtrument in order. To remedy this inconvenience, I have ſought for a ſubſtitute for the crow quill, and tried a variety of ſubſtances, but without ſucceſs. I then conſidered whether an improvement might not be made in the application of the quills themſelves, and to this purpoſe I examined

examined the cauſe of the quills being ſo liable to break, and obſerved that the piece of quill is thruſt through a ſmall hole in the tongue of the jack, projecting only about a quarter of an inch beyond the face of the tongue: That this quill is too ſhort to yield in all its parts, and ſo act properly as a ſpring; but bends only at the place where it iſſues from the hole in the tongue, and works up and down as upon a hinge, in that place; and *there only* is the quill ever known to break.

Thus in Plate III, Figure 6, *a*, is the tongue, *b*, the quill fixed firmly in it, which being too ſhort to act fairly as a ſpring, will bend only at *c*, when it is forced to paſs the ſtring; and by repeated exerciſe muſt neceſſarily break in that part, as any ſpring would do if compelled to act in the ſame manner.

But if this quill could be made longer, or applied ſo that its ſpring ſhould be part of a curve, it would probably preſerve its elaſticity for any length of time, as other ſprings do.

To effect this I have conſtructed the tongue and applied the quill as repreſented in figure 7, where *a*, is the tongue, the top of which is rounded off; the quill is firmly fixed in the hole at *c*, as uſual, but inſtead of paſſing through a length ſufficient to ſtrike the ſtring, it is cut off even with the face of the tongue at *f*. The quill thus fixed with its poliſhed face downwards, is bent upward round the top of the tongue, and then proceeds horizontally the proper length; being kept in the horizontal poſition by the little wire ſtaple *e*, being firmly driven into holes drilled for the purpoſe, but not ſo far as to pinch the quill againſt the top of the tongue; a little ſpace being left for the quill to play in.

From this conſtruction it is manifeſt, that the ſpring of the quill will be in its whole length, but chiefly in the curve *c*, *d*; and that a quill ſo applied will act fairly as a ſpring, and may be expected to retain its elaſticity for years,

years, ſubject to no variations but ſuch as may be occaſioned by alterations in the ſtate of the air, to which all known ſubſtances are more or leſs liable.

Read, 1784. IN the beginning of laſt winter, I had the honour to lay before the ſociety an improved method of quilling a HARPSICHORD. Wiſhing to bring my diſcovery to the teſt of full experiment and to the judgment of abler critics, I forwarded a deſcription and a model of my improvement to a friend in London, requeſting that it might be ſubmitted to the examination of proper judges, and directing, in caſe it ſhould be approved of, that an inſtrument made by one of the firſt artiſts and quilled according to my propoſed method, ſhould be ſent to me. I have accordingly received an excellent double harpſichord, made by Meſſrs *Shudi* and *Broadwood* of London, and quilled according to my method; with this difference, I had rounded off the top of the tongue, and bending the quill over it, kept it in a horizontal poſition by means of a ſmall wire ſtaple; as will be more fully underſtood by referring to my former deſcription. But Mr. *Broadwood* has left the tongue of its full length and uſual form: But made the hole, in which the quill is commonly fixed tight, ſo large, that the quill has free room to play therein; and then fixing the quill below, has bent it round and brought it through this hole; which renders a ſtaple unneceſſary; the top of the tongue anſwering the ſame purpoſe. The principle on which the improvement depends is the ſame in both; but his is the beſt method of executing it.

He informs, however, that one inconvenience occurs viz. the quills being ſo forcibly bent in the curved part, are liable, in ſome inſtances, to ſpring back, and ſo become not only too ſhort to reach the ſtring it ſhould ſtrike, but the projection of the curve will be apt to touch the ſtring behind it, when the ſtop is puſhed back.

To

To explain this, let *a*, *b*, figure 8, repreſent the tongue, *c*, *d*, *e*, the quill, firmly fixed at *c*, then bent upwards and brought through a hole, which is large enough for the quill to play freely therein. But the curved part of the quill at *d*, being ſo forcibly bent, will in ſome inſtances ſpring back (as repreſented in the figure) not keeping cloſe to the back of the tongue, as it ſhould do: And as there is no waſte room, the curve *d*, will be apt to touch the ſtring behind it, when the ſtop is puſhed back, I acknowledge that this inconvenience occurs in ſome few inſtances in the inſtrument Mr. *Broadwood* has ſent me; but would obſerve that as it does not *always* happen, it is a fault in the execution and not in the principle. Yet, as it may be difficult to guard againſt it, I have conſidered how this evil may be effectually prevented.

Inſtead of punching the ſmall hole, in which the quill is to be fixed, ſtraight through the tongue, let it be punched ſlanting downwards; this will relieve the quill from that ſtrained poſition which cauſes it to ſpring back. According to the firſt mode of application the curve formed by the quill will be as at *a*, figure 9, in the ſecond as at *b*. I have conſtructed many tongues in this way, and found none of them liable to the inconvenience complained of, or ſhewing any tendency whatever to ſpring back; but to remove all jealouſy on this head, ſhould any remain, it will be eaſy to drive a ſmall wire ſtaple againſt the bottom of the curve behind, which muſt effectually retain it cloſe to the back of the tongue.

I mention this expedient of the wire ſtaple merely with a view of removing all doubt; but I do not think it neceſſary; the objection being perfectly remedied by the other method: To prove this, I have cut out the entire block between the two holes, in the manner of a mortiſe, and drove a pin acroſs the upper part of it. I then cauſed the quill to lie in this ſlanting mortiſe, and bending it round brought it over the pin; and I found it would remain

main perfectly at eaſe in its birth, although not pinched or reſtrained in any part; *a*, figure 10, repreſents the tongue in front, and *b*, the mortiſe, of which the ſlanting ſhape cannot be ſeen in this view; but will be better underſtood by obſerving the poſition of the quill in figure 11, where *a* is a profile of the ſame tongue, *b*, *c*, the quill lying in the mortiſe, and *d*, the pin over which the top of the quill paſſes.

I have need to apologize to the ſociety for directing ſo much of their attention, to an object which may appear to ſome to be of little importance. To the muſical tribe, however, this improvement will preſent itſelf in a different light. Many perſons who play very well on the harpſichord, are not able to keep the inſtrument in order: And to ſend for a perſon to repair the quills and tune the inſtrument as often as it ſhall be neceſſary, is not only troubleſome and expenſive, but ſuch aſſiſtance is not always to be had, eſpecially in the country. And for theſe reaſons many a good harpſichord or ſpinnet lies neglected and the ſcholar looſes the opportunity of practice. To ſuch perſons a method of quilling that ſhall ſeldom want repair is a *diſideratum* of no ſmall importance. And this, I flatter myſelf I have accompliſhed.

The difficulty of *quilling* being thus removed, I conſidered in what manner *tuning* might be made eaſy to the practitioner in muſic. Harpſichords are tuned by means of *fifths* and *thirds*; but ſuch is the muſical diviſion of the monochord as to make it neceſſary, that none of theſe *fifths* or *thirds* ſhould be perfect; an allowance muſt be made; and to do this with judgment, ſo that the chords may be good and the inſtrument be in tune, requires much attention and practice. Of the numbers that play, there will not be found one in an hundred that can tune a harpſichord. To render this taſk eaſy, I have procured *twelve tuning forks*, for the *twelve ſemitones* of the octave; theſe I had perfectly tuned; and as they will not be ſenſibly af-

fected by any change of weather, they remain as ſtandards. I take it for granted that any perſon at all accuſtomed to muſical ſounds can tell when one tone is *in uniſon* with another; and that a very little practice will enable him to tune one ſound *an octave* to another, theſe conchords are ſo manifeſt that they cannot eaſily be miſtaken. There is then nothing to be done but to tune the twelve ſtrings in uniſon with the twelve forks; this will fix the ſcale, or temperature for one octave, which is the whole difficulty; the reſt of the inſtrument is eaſily tuned by uniſons and octaves to the ſcale, ſo aſcertained*.

Having, I hope, fully accompliſhed the deſign I had in view when I turned my thoughts to this ſubject, I ſhall now take leave of it; and ſhall be highly gratified if I find others benefited by my attentions, although in a matter of no very ſerious import.

Nov. 1784.

Deſcription of a further Improvement in the HARPSICHORD.

Read January 28, 1786.

IN a former paper read before the ſociety, reſpecting an improved method of quilling a HARPSICHORD, I made ſome apology for troubling you with a ſubject not ſtrictly within the limits of your view as a philoſophical ſociety, and which might appear to ſome of ſmall importance. At the ſame time I took formal leave of a purſuit which had accidentally engaged my attention, and which I had obtruded upon your's. Notwithſtanding this, I find myſelf under a neceſſity of again requeſting your indulgence, whilſt I deſcribe a diſcovery I made in Auguſt laſt, of a ſtill further improvement to the ſame purpoſe.

Having

* My ſet of forks are tuned from the middle C ſharp to the C above, incluſive.

Having ſucceeded to the extent of my expectation in a more advantageous way of applying the crow quill in common uſe in a harpſichord, I thought to reſt content with that improvement; which had principally for its object the duration of the quill's elaſticity, and of courſe the duration of the equality of touch. But notwithſtanding the long eſtabliſhed prejudice in favour of the crow quill, and the prevailing opinion that no ſubſtance can ſupply its place to advantage, I think a candid critic will allow that one of the following poſitions is founded in fact, and the other in reaſon.

Firſt. Although the three ſtops of a harpſichord ſhould be quilled to the beſt advantage, the reſult of the whole will be an obſervable jingle or tinkling between the quills and wires, which depreciates the dignity and ſweetneſs of the inſtrument. The beſt harpſichords are ſo cenſurable for this imperfection, that the *Forte Piano*, which is free from it, ſtands a chance of rivalling that noble inſtrument, for this cauſe only; being far inferior in every other reſpect.

Second. Is it not reaſonable to ſuppoſe that ſo long a ſtring, ſo advantageouſly ſtretched over ſo large a box, ſhould yield a greater body of tone, than that which is produced by the impulſe of a quill? If the quill be made very ſtiff, this will render the touch diſagreeable and encreaſe the jingle, but not add to the *body* of tone. One reaſon why the quill does not draw a fuller tone from the ſtring, I ſuppoſe to be the ſmallneſs of its contact. The back of a quill is a portion of a circle, the extended ſtring is a right line, and a circle can touch a right line only in a point; the contact therefore muſt be ſo very ſmall, that mere ſtrength of impulſe is not ſufficient to put the ſtring into full vibration.

The method I am now to deſcribe of quilling, or rather *tonguing* a harpſichord, I have found by experiment, to draw forth the powers of the inſtrument to a ſurpriſing

effect, cauſing it to yield a full and pure body of tone, free from all jingle and very pleaſant to the ear.

N. B. What hath hitherto been called the tongue of the jack, I ſhall denominate the *palate;* and the ſubſtitute I have made for the quill, I ſhall call the *tongue.* The propriety of this will appear in the deſcription.

Let A, figure 12, repreſent the palate in front, with a mortiſe cut through it for the tongue to work in. B, is the tongue, having two ſmall holes drilled through it, one in the centre of its motion and the other at a little diſtance behind, for the reception of one end of a wire ſpring hereafter mentioned.

Plate III.

Figure 13, is the palate in profile, with the tongue properly mounted and moveable on the centre pin. This figure alſo ſhews how the palate muſt be hollowed in behind to expoſe the root of the tongue, and the ſmall hole in it for the reception of one end of the wire ſpring.

Figure 14, is a back view of the palate, ſhewing the groove in which the hair ſpring of the jack lies, and a ſmall wire ſtaple at *b*, to which the lower end of the ſteel ſpring is to be faſtened.

Figure 15, is the ſpring which is to govern the tongue. It muſt be of fine ſteel wire, ſomewhat annealed by being forcibly rubbed between pieces of leather or cork, and is formed by winding the wire backwards and forwards with a tight hand, over pins driven deep and firm into a piece of wood. As the palate muſt play freely within the fork or jaws of the jack, the windings of the ſpring muſt not exceed the width of the palate. The upper end of the ſpring being run through the ſmall hole in the root of the tongue and bent round, ſo as to ſecure it, and the ſuperfluous part cut off; the lower end of the ſame ſpring muſt be run under the little ſtaple (*b*, figure 14,) and bent upwards with a gentle ſtrain, ſo as to hook it on and ſecure it to that ſtaple; the ſpring will then operate with all its elaſticity, and the tongue will be ſubjected to its operation.

Figure

Figure 17, repreſents the palate in a back view with the zig zag ſpring faſtened by one end to the root of the tongue, and by the other to the little ſtaple.

To prevent the tongue from riſing by the force of the ſpring above a horizontal poſition, there muſt be a wire ſtaple driven in the front of the palate immediately above the tongue (as at *a*, in figure 12 and 13;) and the tongue, if of wood, ſhould be armed with a ſmall piece of ſoft leather juſt under the ſtaple, to prevent noiſe.

It muſt be left to future experiment to determine the moſt proper of all ſubſtances of which the tongue ſhould be made; different ſubſtances drawing different tones from the ſtring. After many eſſays to this purpoſe, I have concluded to furniſh my harpſichord in the following manner.

The tongues of the firſt uniſon are of *Ben ſole-leather*. Thoſe of the ſecond are of a ſoft leather faced with Morocco, ſuch as is frequently uſed in harpſichords, though applied in a different way, and the tongues of the octave are of wood, ſuch as pear tree, laurel, or any wood of an even grain and not too hard in ſubſtance. But all mounted on ſprings, as above deſcribed, and their faces well poliſhed with black lead where they come in contact with the ſtrings.

My reaſons are. The ſole-leather produces a full, ſweet and vigorous tone from the firſt uniſon. The ſecond uniſon, which is the piano of the inſtrument when the pedal is preſſed, is furniſhed with Morocco leather, which draws a full but more ſoft and ſmothered tone from the ſtring. And the octave is ſtruck with wooden tongues for the ſake of vivacity or brilliancy, which is the genius of that ſtop; yet I am not ſure but that the octave alſo had better be ſtruck with ſole-leather, like the firſt uniſon*.

A harpſichord thus furniſhed, will produce a body or quantity of ſound, and a purity of tone, that will aſtoniſh at

* Becauſe, after the ſtroke has been given, the wooden tongue repaſſing the ſtring, yet in vibration, makes a jingle, which the leather tongues do not.

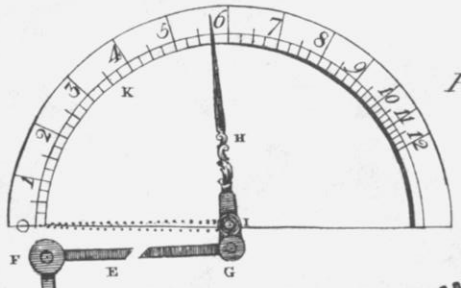
at the firſt hearing, much reſembling the diapaſon ſtop of an organ. And it is manifeſt that if the touch be well regulated at firſt, it will not afterwards be ſubject to alteration for a long courſe of time. The touch is in part regulated by the ſtrength of the ſerpentine ſpring and the number of its zig zag evolutions; and in part by the manner of rounding off the tip of the tongue; for the tip of the tongue muſt not be cut off ſquare, (in which caſe, the ſtring would leave the tongue too abruptly and cauſe a diſagreeable twang,) but ſhould be ſlanted off from underneath, and its extreme point rounded and well poliſhed by rubbing it very hard with a piece of black lead. As to the ſtrength of the ſpring, four ſizes of wire, viz. from n°. 4 to n°. 8, will be ſufficient for the whole inſtrument; but the touch is more immediately regulated by rounding off the tips of the tongues by the preſſure and poliſh of the black lead, more or leſs, as occaſion ſhall require. When the tongues are of wood, a ſtroke or two of a fine file will be neceſſary to take off the ſquare edge left by the knife, previous to the poliſhing it with the black lead.

After all, a harpſichord juſt furniſhed in this way, will not be ſo pleaſant to the touch or to the ear as it will be after a few weeks uſe; when the ſtrings will, by repeated friction, have rounded off and poliſhed the tips of the tongues, and have made for themſelves a broad bearing or contact, which cannot perhaps be ſo accurately produced by any care of the workman.

Laſtly, it is ſcarce neceſſary to obſerve that the ſerpentine ſpring and the root of the tongue muſt be compriſed within the thickneſs of the jack; otherwiſe they will be apt to interfere with the ſtring behind, when the ſtop is puſhed back.

F. HOPKINSON.

Obſervations



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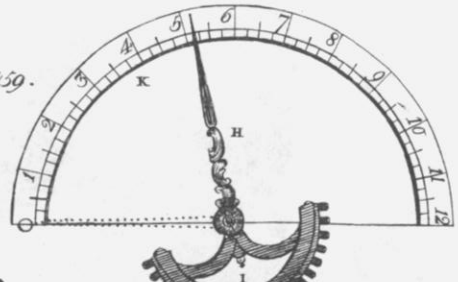

Fig. 1.

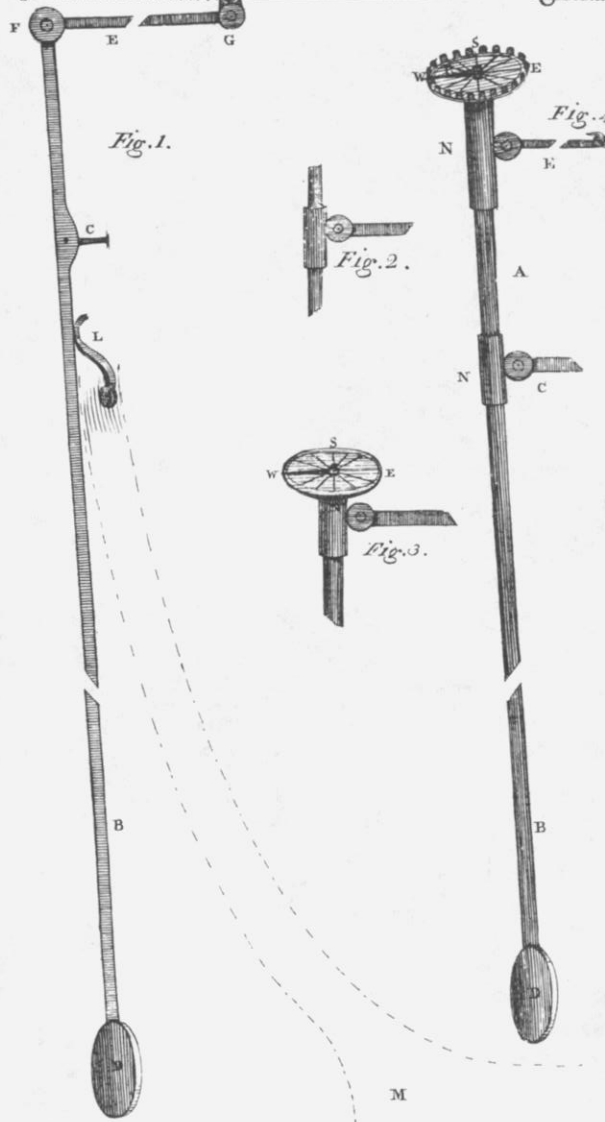

Fig. 2.

Fig. 3.

Fig. 4.

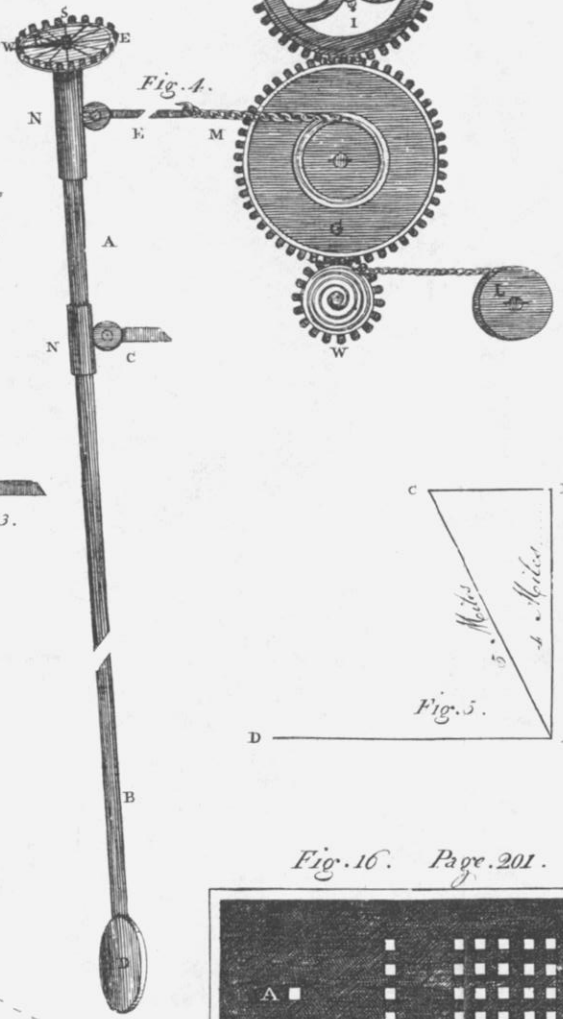

Fig. 5.

Fig. 16. Page. 201.

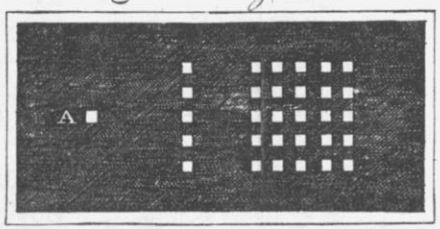

Fig. 6.

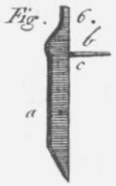

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

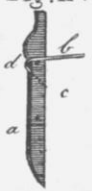

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Fig. 12.

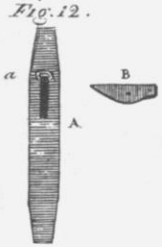


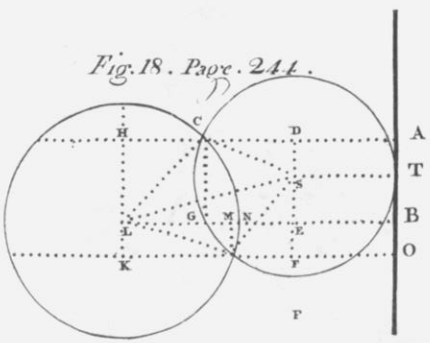
Fig. 13.

Fig. 14.

Fig. 15.

Fig. 17.

Fig. 18. Page. 244.



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